CENTRAL INTELLIGENCE AGENCY

50X1-HUM

INFORMATION REPORT

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COUNTRY	USSR (Moscow Oblast)	REPORT	
SUBJECT	Description of Gyroscopes Used in Guidance of V-2 Missile	DATE DISTR.	12 February 1954
		NO. OF PAGES	8
DATE OF INFO.		REQUIREMENT	
PLACE ACQUIRED		REFERENCES	

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(Note: Washington Distribution Indicated By "X"; Field Distribution By "#".)

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NO. OF ENCLS. (LISTED BELOW)

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A. The standard equipment of the V-2 missile includes two gyroscopes, the pitch gyroscope (Horizont) (with D-gyro), and the yaw and roll gyroscope (Vertikant) (with E, A-gyro).

The Pitch Gyroscope (Horizont)

The horizontal gyro, suspended in a gimbal system, is installed in such a way that the stabilized gyro axis can be used as the reference basis for the trajectory. In firing position, the missile is exactly vertical. The missile axis is aligned with the gyro axis. Through inclination of the missile during flight (in the firing direction), the angle between the gyro axis and the missile is changed. This change is used to control the missile electrically by a potentiometer. The slider of this command-potentiometer changes according to the angle and transmits

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a proportional command-voltage over a special amplifier (mixer) to the rudder system. The slider of the potentiometer is coupled with the gyro. The potentiometer itself is mechanically connected to the base plate by a programming gear and therewith with the missile body. The command-voltage for the command-potentiometer is supplied by a special dry-cell battery (50V, 0.5 AH) [see page 5]. The airborne battery is switched on automatically at the start by a relay. During pre-firing tests this voltage is taken from a power supply unit in the ground station. The voltage is examined for magnitude and correct polarity by a supersensitive polarized relay in the ground station.

The potentiometer is connected in such a manner that an inclination of the missile in a positive sense (in firing direction) results in a negative command. That means that the voltage appearing on the potentiometer applies a negative control current to the amplifier (mixer), which actuates the rudder system [see page 6]. The output of the mixer unit is proportional to the input voltage with no delays. The control current is checked in the ground-station by a milliammeter until the moment of starting. The control circuits can be broken by a relay contact and bridged again by an ammeter in the ground-station control desk. In later developments shunt resistors had been used instead of relay contacts in order to simplify the switching.

The pitch gyro controlled rudder servos II and IV. [For location of the rudders see page 6.] Both rudder servos work synchronously. Synchronization is achieved by potentiometers which are coupled to the rudder servos II and IV. The rudder movement is proportional to the voltage input. Each rudder servo (II and IV) drives an external control vane and an internal carbon vane. The internal carbon vanes lay within the gas stream and are only effective as long as the missile is driven. This system is a stable dynamic system. When test missile control systems are not properly adjusted, the rolling motion can be observed with the naked eye.

To guide the missile in its trajectory, the potentiometer is adjusted by a programming motor. The programming motor is switched on by a timeswitch five seconds after the start and switched off again approximately in the 42nd second after firing. The programming motor is a stepping relay. Plus impulses are fed to a magnet coil from the 27V battery through a chopper. The magnet coil operates a plunger which moves a gear one tooth forward with each impulse. Connected to this gear is a cam whose shape is mathematically calculated. The cam shape determines the curvature of the trajectory until combustion cut-off. A cam follower is coupled with the command potentiometer, and the desired angle of inclination is transmitted in the form of a command voltage via the mixing unit to the rudder servos. The stepping relay was given preference over a motor because it had better inherent speed regulation.

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The gyro is erected as long as the missile stands ready for firing. The erection system prevents wandering of the gyro. It consists of a normal pendulum and a torquer [see page 7]. The torquer is installed on the gimbal ring of the gyro and consists of a permanent magnet and two coils. According to the pendulum position the coils exercise a turning moment on the gyro axis and erect the gyro.

The gyroscope power is supplied by a frequency stabilized transformer. With a voltage: 3 x 40V, and a frequency 500 cycles, about 10,000 rpm, gyro type KA 6 (60mm rotor diameter) is an induction motor with short-circuited rotor.

The run-up time of the gyro is about three to five minutes. The run-down time is approximately 20 minutes and the usable range after switch-off is approximately one minute.

As long as the missile is standing, ready for firing, the gyro power is furnished. At take-off, the gyro is switched off and runs down. The rotor is mounted in special low friction bearings.

Among special characteristics of the potentiometer are a special gold-alloy which gives constant resistance within wide temperature limits. The single windings are so close to each other that the voltage change takes place continuously and not in discrete steps.

Two types of course compasses from the firms "L.G.W." and "Anschuetz" existed at the end of World War II. One of the main differences was the construction of the programming motor. Besides the above described design, a direct-current motor with centrifugal governor existed which drove a cam, which was a ceramic drum with sprayed-on silver layer. According to certain rotation angles, single resistors were connected in the circuit corresponding to a certain control command. This design was later discarded.

The Yaw and Roll Gyroscope (Vertikant)

This gyro (KA 6) furnishes the reference for course control and twisting roll stabilization. A liquid contact pendulum is used for erection of this gyro. Baldrian was used as liquid. Alignment, prior to firing of the gyro, was done electrically from the ground station by a highly sensitive moving-coil relay made by Siemens. The supply of these relays was very difficult. About 10 to 15 old relays were on hand. The importance of this relay was not immediately recognized. As a substitute polarized telegraph relays were used. The potentiometers were connected with a mixing unit. Two types existed here also: "L.G.W." (Luftfahrt Geraete Werke, Air Force Equipment Works) and "Anschuetz". This gyro was erected by an electromagnetic system (torquer) as in the pitch gyro. The erection operated also during the flight.

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General Information

In the USSR instructions were given to reconstruct all test equipment. Criteria were too rigid at first; the first specimens were tested to destruction. All destroyed equipment and single parts were kept. Many test instruments could be taken over completely. The potentiometers consisted of gold- platinum wire, 100 turns with 1mm spacing. One volt command-voltage resulted in one milliampere control-current.

The E-potentiometer in the yaw and roll gyroscope worked on the internal carbon vanes 1 and 3. The A - potentiometer also worked on the internal carbon vanes 1 and 3.

The D-potentiometer in the pitch gyroscope worked on the internal carbon vanes 2 and 4 and on the external control vanes II and IV. Inaccuracies were adjusted by two trim motors on the external control vanes I and III [see page 7].

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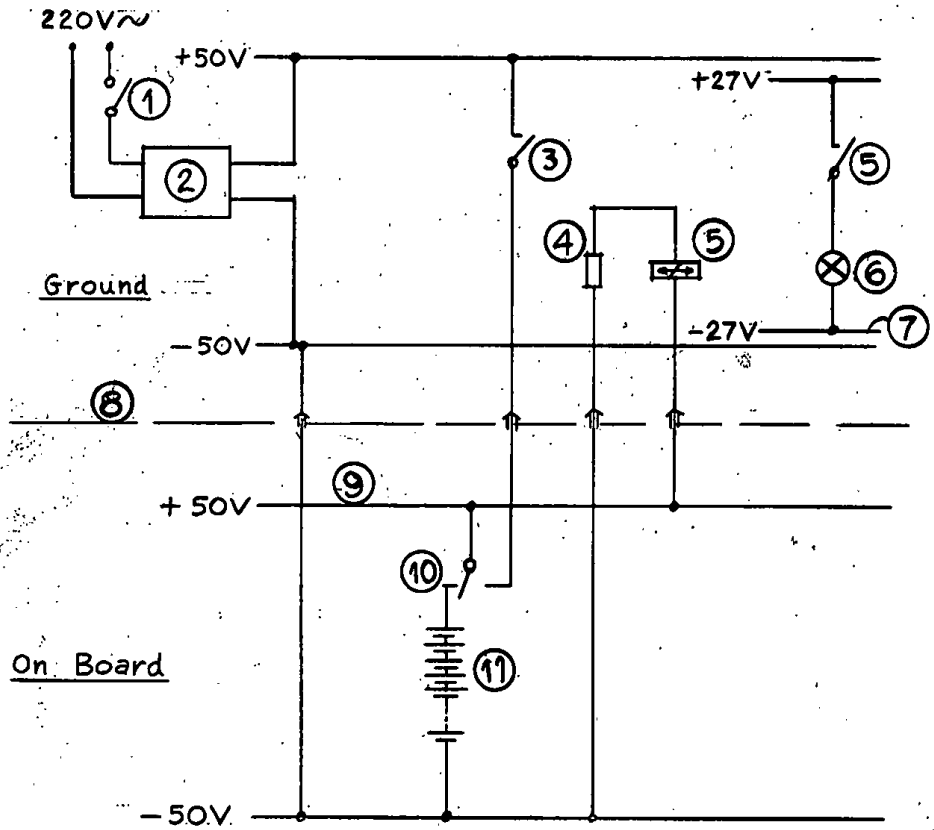
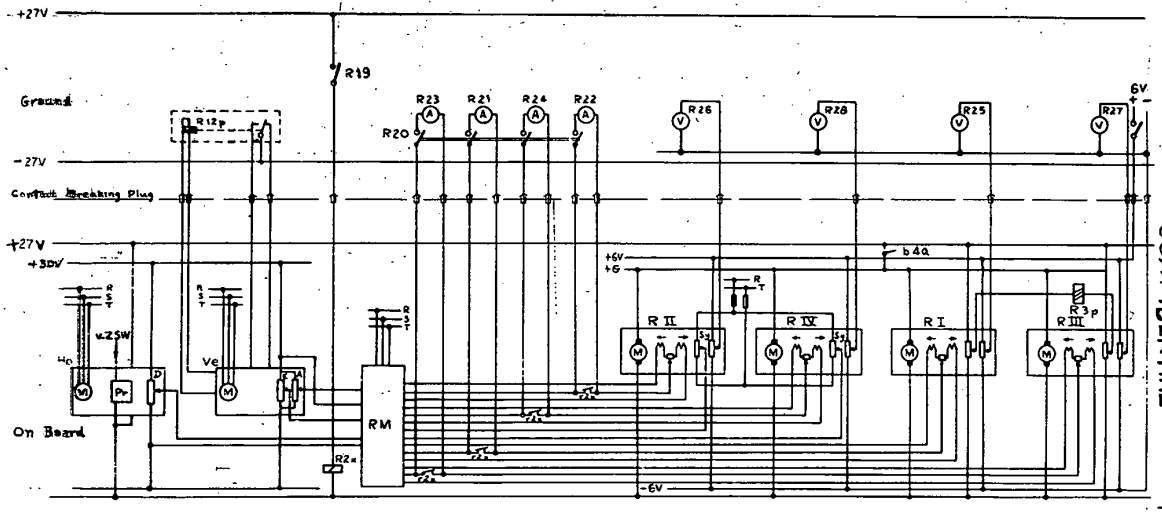


POWER SUPPLY V-2

1. Main Switch
2. Power Supply Unit
3. Interlocking Contact
4. Compensating Resistance
5. Polarized Relay
6. Signal Lamp
7. 27V Gs - System Ground Station
8. Contact Breaking Plug
9. Voltage In On Board System
10. Interlocking Contact
11. Battery



INTERCONNECTION DIAGRAM V-2

R12p = Supporting Relay (Ground)
R19 = Control Current Switch
R21-R24 = Control Current Indicators
R25-R28 = Rudder Position Indicators
6V = Rudder Position Voltage - 6V
R-S-T = A/C Power
Ho = Pitch Gyroscope
Ve = Yaw & Roll Gyroscope
R2x = Control Current Breaker
RM = Amplifier (Mixer)

b4a = Propulsion Unit Contactor
+G = D/C For Rudder Servos
R3p = Trim Relay
RI = Rudder Servo I
RII = Rudder Servo II
RIII = Rudder Servo III
RIV = Rudder Servo IV
Sy = Synchronizing Potentiometer
Pr = Programming Motor

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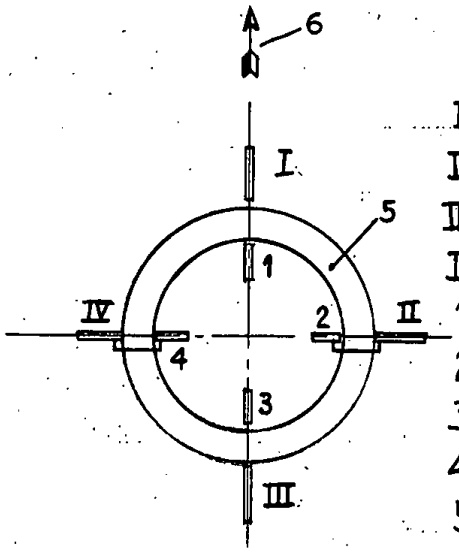
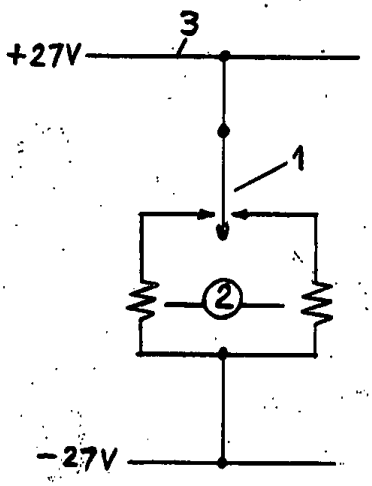


I- External Control Vane I
II- External Control Vane II
III- External Control Vane III
IV- External Control Vane IV
1- Internal Control Vane 1
2- Internal Control Vane 2
3- Internal Control Vane 3
4- Internal Control Vane 4
5- Rudder Ring
6- Firing Direction

RUDDER ARRANGEMENT V-2



1- Pendulum
2 Movement Transmitter
3- On Board Voltage

PENDULUM WIRING DIAGRAM V-2